RESEARCH MANAGEMENT DIVISION REVIEW FOR THE FISCAL YEAR 1984/85

RMD Report 85/32

Alberta
ENVIRONMENT
Environmental Protection Services
Research Management Division

87-01350/

RESEARCH MANAGEMENT DIVISION EMBLEM

The Emblem represents the interdisciplinary and holistic nature of the Division's environmental research programs. Each of the five sections of the symbol represent comprehensive programs on air, water, land, humans and their constant interaction. The sections converge to form a cohesive chain, characteristic of an effective research organization. This cohesive bonding makes the sections blossom into the environment in the form of a flower — an Albertan wild rose.

RESEARCH MANAGEMENT DIVISION

REVIEW

FOR THE FISCAL YEAR 1984/85

RESEARCH MANAGEMENT DIVISION
Alberta Environment

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This report may be cited as:

Pringle, J.I., ed. 1986. Research Management Division review for the fiscal year 1984/85. Prep. for Research Management Division, Alberta Environment. RMD Report 85/32. 59 pp.

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REVIEW

FOR THE FISCAL YEAR 1984/85

RESEARCH MANAGEMENT DIVISION
Alberta Environment

RMD Report 85/32

1986

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INTRODUCTION

The objectives of the Research Management Division (RMD) are:

1. To provide timely and authoritative scientific and technical information to other operational divisions within Alberta Environment;
2. To plan and co-ordinate the scientific environmental research planning requirements of the department; and
3. To publish research on environmental matters that are pertinent to departmental and provincial needs.

To realize these objectives, the Research Management Division aids in the co-ordination of all the department's environmental research and ensures that the available research dollars are well spent on activities that respond to priority needs. To this end, RMD acts as a co-ordinator for research carried out on behalf of the department at the Alberta Environmental Centre in Vegreville. As well, divisional staff constantly interact with other line divisions of Alberta Environment to keep their programs current and of direct applicability to the department.

In its research management capacity, the Research Management Division actively manages or oversees a number of environmental research projects. As a rule, proposals for projects are solicited by RMD as needs are identified and terms of reference developed. However, unsolicited proposals may be submitted through other divisions of Alberta Environment or directly to RMD. All are reviewed in the light of departmental objectives and program requirements.

Divisional Organization

The division combines diverse skills such as project management, budgeting and financial control, contracting, and publication editing with comprehensive knowledge in many scientific areas pertinent to environmental research. The division's expertise, which allows for a comprehensive approach to environmental problem solving, is drawn from such fields as hydrology, climatology, pedology, biology, meteorology, ecology, and sociology.

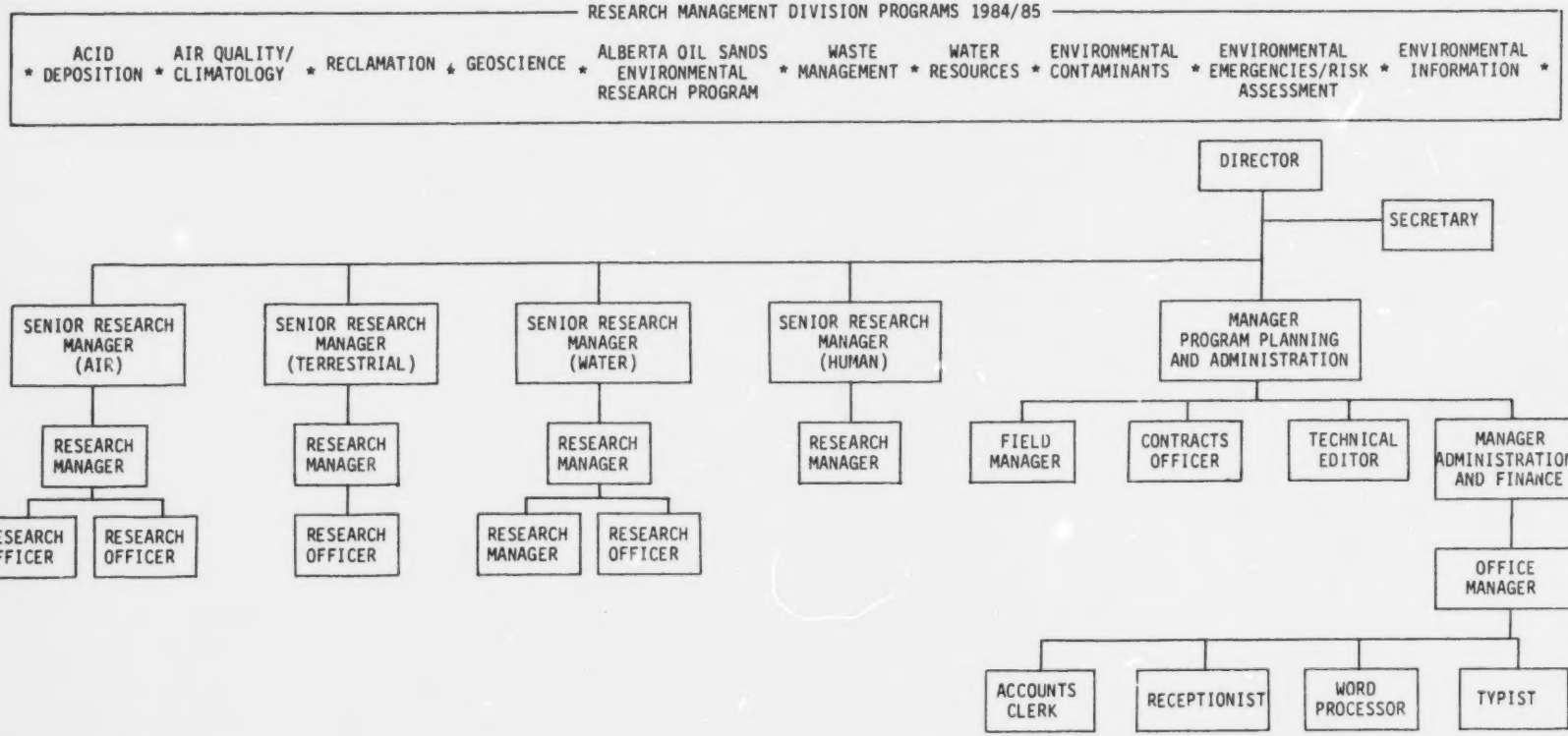
The organizational structure of RMD merges a functional management mode, comprising four scientific systems or working groups (air, human, terrestrial, and aquatic), into a matrix system with a number of well-defined scientific research programs. The prime advantage of this structure is its flexibility, allowing for an interdisciplinary approach to environmental research. For instance, the division's work in the area of acid deposition includes research on the complex interface between the atmosphere and biosphere, that is, how atmospheric pollutants affect soils and vegetation.

During the 1984/85 fiscal year, the division's research programs were reorganized to include:

1. Acid Deposition;
2. Air Quality/Climate;
3. The Alberta Oil Sands Environmental Research Program (AOSERP);
4. Environmental Contaminants;
5. Environmental Emergencies and Risk Assessment;
6. Environmental Information;
7. Geoscience;
8. Reclamation;
9. Water and Waste Management; and
10. Water Resources.

As RMD's programs are developed, each is defined by a comprehensive descriptive document that is updated regularly to keep its objectives current. Environmental concerns in Alberta are continually examined and incorporated into the division's active programs. Should it be necessary, new programs are developed while others may be terminated. Budget funds are allocated to each of the programs on the basis of priorities determined by Alberta Environment.

A large portion staff time was spent participating in the departmental, interdepartmental, and interagency committees that co-ordinate research programs. The division was represented on 47 committees, 6 being departmental committees, and the remainder interagency or interdepartmental committees such as the Reclamation Research Technical Advisory Committee (RRTAC) and the Federal/Provincial Long-Range Transport of Atmospheric



Research Management Division Organization Chart, 1984/85

Pollutants (LRTAP) committees. Involvement in these committees has enhanced the effectiveness of the division and its management capabilities, and has ensured that the professional staff have maintained an awareness of current environmental research activities in Alberta and elsewhere.

To further the division's expertise, RMD staff also attended and presented papers at scientific conferences and meetings in a variety of locations in Canada and the United States. In addition, they sponsored workshops and seminars on various research topics.

Within the administrative arm of RMD, emphasis continued to be placed on the streamlining of the division's administrative procedures with the aim of eventually implementing a computerized management system.

Report Organization

This report is based on the broad programs noted earlier in the introduction. Some specific references may be made either to location or to systems where appropriate. Projects that fall under AOSERP have been incorporated into the descriptions of the other programs.

ADMINISTRATION

The projects identified in this section are contracts entered into for administration purposes only. These contracts cover the following areas:

1. Alberta Environmental Research Trust Grant;
2. Catering for the Mildred Lake Research Facility;
3. Outside (non-government) review of research reports; and
4. Support for seminars conducted by recognized visiting scientists.

PROJECTS

Alberta Environmental Research Trust

The Alberta Environmental Research Trust (AERT) was created in the spring of 1971 by enactment of the Legislative Assembly of Alberta to provide a mechanism for the expansion of applied and fundamental research and development relative to environmental improvement. Practical projects relevant to Alberta are encouraged. AERT should be considered as a source of funds for research that would otherwise not be funded by industry, university, or government departments.

A Grants Advisory Committee is appointed by the Board of Trustees to review research proposals and offer scientific advice. This committee consists of specialists in various fields who are chosen for their understanding of specific environmental problems, and includes two representatives from RMD.

Contractor: Alberta Environmental Research Trust (AERT)
Funding: $340 000.00

Mildred Lake Camp Catering

To support AOSERP research, the Research Management Division operates the Mildred Lake Research Facility for project and scientific staff working in the Athabasca Oil Sands area.

The Mildred Lake Scientific Research Facility is situated near Mildred Lake, approximately 31 miles north on Highway 63 from Fort McMurray, Alberta.

This contract provides for the catering service of the camp, preparing and serving food for a minimum of seven persons and a maximum of 60 persons.

This project is an integral component of the Alberta Oil Sands Environmental Research Program (AOSERP).

Contractor: Mr. John Merrick, Bull Caterers Ltd.
Funding: $116 434.85

Review and Comment on a Report Entitled "Acoustical Doppler Radar Observations of Wind in the Ellerslie Region of Alberta"

This project provided for outside review and comment on the above-mentioned report. Although the report was reviewed internally, the contractor has considerable expertise in the atmospheric sciences, and therefore provided an invaluable scientific review of the report.

Contractor: Dr. Edward P. Lozowski

Funding: $500.00

Zoology Seminar Series: Seminars Conducted by Recognized Visiting Scientists

RMD has funded the visiting speakers for this seminar series in past years with excellent results. In addition to the main seminar series, Alberta Environment also benefits through staff attendance at noon-hour seminars at the University of Alberta, special seminars held within Alberta Environment, and half-day sessions spent in direct consultation with the scientists. The participating staff from Pollution Control Division and Planning Division strongly support this program.

Contractor: Dr. E.E. Prepas

Funding: $2500.00

ACID DEPOSITION RESEARCH PROGRAM

The Acid Deposition Research Program (ADRP) was designed to plan and implement research specific to Alberta that will concisely address the following objectives:

1. To characterize sensitive environmental ecosystems and develop methodologies to identify and/or predict measurable short- and long-term effects of acidic or acidifying substances on Alberta ecosystems;
2. To determine the characteristics and quantities of both long-range emissions and those generated locally, and to examine their effects on the environment;
3. To develop a basis and approach for preventive strategies and environmental protection; and
4. To co-ordinate departmental research on acid deposition with other private and public agencies in Alberta and the rest of Western Canada.

In addition, the program will provide scientific information for reviewing and evaluating Alberta's air quality standards, and will assist in present and future planning of provincial industrial development. Finally, it will provide a good understanding of the potential for environmental acidification and will aid in sound, long-term environmental management.

The division maintained, on behalf of the department, a high degree of involvement in various Acid Rain/Long Range Transport of Air Pollutants (LRTAP) committees. These committees are composed of representatives from federal and provincial governments and the private sector.

PROJECTS

Air Quality Data Acquisition - Sandalta Air Quality Trailer

The emission of acid forming substances into the atmosphere and their deposition and subsequent impact on the ecosystem are of current concern. As the magnitude and intensity of deposition follows an episodic pattern, the response of vegetation to pollution episodes is dependent upon the relationship and timing of the episode and the physiological development of the receptor. Therefore, air quality/atmospheric data must be interfaced with receptor-response measurements.

To facilitate the implementation of a biomonitoring research program, an air quality monitoring station was established in the vicinity of a permanent sample plot on the Sandalta lease in the oil sands area. The station continuously measures meteorological data and ambient concentrations of acid forming gases and integrates measurements of wet- and dryfall particulate matter. Data generated will be used to develop numerical models for interfacing atmospheric/air quality data to plant response measurements. This project began in 1982 is expected to continue until 1987.

Contractor: Mr. Paul Vetro, Air Quality Management, Western Research, Division of Bow Valley Resources Services Ltd.

Funding: $69 610.00

Atmosphere-Biosphere Interface: Application of a Numerical Model to Assess Growth Response of Jackpine to Chronic Atmospheric SO_2 Exposures

Plant response to chronic pollutant exposure is of primary importance in any investigation of natural ecosystems. A multivariate non-linear regression model has been developed and verified by Dr. Nosal to explain the relationship between the growth response of soybean and annual basal area increment of lodgepole pine to ambient chronic atmospheric sulphur dioxide (SO_2) exposures. The main objective of this project is to apply the model to the historical data base in the AOSERP area to assess the response of annual basal area increment of jackpine to chronic atmospheric SO_2 exposure. The project will be continued in 1985/86.

Contractor: Dr. Miloslav Nosal, Statscon, Statistical Consulting Co.
Funding: $22 500.00

Atmosphere-Biosphere Interface: Verification of the Model to Determine the Frequency Distribution of SO_2 Ground Level Concentrations

A climatological air quality dispersion model was developed to generate frequency distributions of ground level concentrations of SO_2. Prior to integrating the predicted air quality data with tree core data to assess the impact of acidifying substances on tree growth, however, it is essential that the model be verified. This project will validate the applicability of the model for predicting air quality data in the AOSERP study area.

Contractor: Dr. Miloslav Nosal, Department of Mathematics and Statistics, University of Calgary
Funding: $12 500.00

Chemical Analysis of Summer Precipitation in the Oil Sands Area

Atmospheric pollutants are scavenged from the air by rainfall. Since 1976, the Research Management Division has collected rainfall on an event basis in the AOSERP area. Analysis of the rain provides some indication of the amount and distribution of ion concentrations and insoluble/soluble metals present in the rainfall. Emissions from industrial sources in the AOSERP region are under careful scrutiny. The concern is that these parameters will change in space and time as a result of additional atmospheric emission sources. The continued chemical analysis of rainfall will delineate any changes in the ionic characteristics and spatial distribution of wetfall deposition resulting from the emission of pollutants from industrial sources in the area. Objectives of the study are to identify trends in the chemical characteristics of rainfall and to develop the most appropriate and successful sampling and analysis techniques for precipitation chemistry. This will provide a data base to quantify changes in the input rate of atmospheric trace substances into sensitive ecosystems.

Contractor: Mr. Don LaBerge, Analytical Services, CHEMEX Labs (Alberta) Ltd.
Funding: $36 000.00

Determination of Dispersion, Pollutant Trajectories, Precipitation Acidifying Processes and Deposition Rates Through Aircraft Measurements in the AOSERP Area - Phase III

Initiated in 1982 as a co-operative effort between the Alberta Research Council and the Research Management Division, the major thrust of Phase III will be to investigate the plume dispersion and transport of acid forming emissions to gain insight into the physics and chemistry of point source plumes. The chemical transformation and rate of removal of these emissions by both clouds and precipitation will also be investigated. The main objectives of the research are:

1. To determine the transport and dispersion of SO_2 and NO_x emitted in the AOSERP area;
2. To determine the transformation of SO_2, SO_4, and NO_x in the AOSERP area; and
3. To determine the redistribution and rate of removal of pollutants from the atmosphere by clouds and precipitation in the AOSERP area.

The airborne field measurements will provide baseline information for pollutant trend analysis and will be important for tracking pollutant/airmass trajectories from the emission sources.

Contractor: Dr. M. English and L. Cheng, Atmospheric Sciences Department, Alberta Research Council

Funding: $55 000.00

Development of an Acid Deposition Research Program for Alberta Environment, Research Management Division

The Contractor, in collaboration with Dr. Krupa and RMD research managers directly involved with the Acid Deposition Research Program, will develop a research program to address the question "Are there detectable impacts of aerial emissions of acidic or acidifying substances on the forest ecosystem in the AOSERP area?"

Contractor: Dr. R. Kickert

Funding: $3000.00

Dry Deposition of Sulphur Dioxide in the Athabasca Oil Sands Area

The measurement of acid forming emissions deposition relies on both wet- and dryfall accumulation. In Alberta, dry deposition rates are not well documented. This project, currently being conducted in the Athabasca Oil Sands area, will continuously measure ambient concentrations of sulphur dioxide and collect integrated data on the quality and quantity of dry- and wetfall particulate matter. The study will promote the development and field testing of measurement techniques for the dry deposition of sulphur dioxide and the subsequent derivation of dry deposition velocities.

The project is a specific component of an integrated research effort to assess the impact of total acid deposition on terrestrial ecosystems. It will provide the information necessary to assess the total deposition occurring in the vicinity of an oil sands plant and to define source-receptor relationships.

Contractor: Mr. Paul Vetro, Air Quality Management, Western Research
Funding: $103 620.00

The Effect of SO_2 from a Sour Gas Processing Plant on the Development of Endomycorrhizae (VA) on Phleum pratense L. - Phase I

This study will determine if SO_2 emission from sour gas plants has a detrimental effect on the symbiotic mycorrhizal relationship of some grasses, thereby threatening the viability of these agriculturally important species.

This study will relate the physiological effects of SO_2 on *P. pratense L.* to their subsequent effect on endomycorrhizae (VA) inhabiting the roots. In Phase I, sites that have been affected and not affected by SO_2 will be used to discern the plant-mycorrhizal relationships. Plant communities will be described, and representative plant and soil samples will be collected for further analysis.

Contractor: Dr. D. Parkinson and J. Clapperton, Kananaskis Centre for Environmental Research, University of Calgary
Funding: $1875.00

The Effect of SO_2 from a Sour Gas Processing Plant on the Development of Endomycorrhizae (VA) on Phleum pratense L. - Phase II

In Phase II of this study, laboratory fumigation experiments will be used to study SO_2 effects on mycorrhizal root infection, root biomass, and root exudation.

Contractor: Dr. D. Parkinson and J. Clapperton, Kananaskis Centre for Environmental Research, University of Calgary

Funding: $9280.00

Effects of Deposition of Acid Forming Substances on Organic Matter Decomposition/Nutrient Cycling in a Forest Ecosystem

This project is part of the ecological monitoring research in the AOSERP area. This study examines nutrient cycling and organic matter decomposition as influenced by acidic deposition. Recent scientific literature suggests that soil acidification can retard organic matter decomposition through changes in soil microbial activities. This effect in turn can influence nutrient release and availability for higher plants. In addition, soil acidification is known to increase the leaching of key elements required for plant growth.

Contractor: Dr. D. Parkinson, Kananaskis Centre for Environmental Research, University of Calgary

Funding: $49 962.00

Establishment of Summer Precipitation Collection Network in the Oil Sands Area

Since 1976, the Research Management Division (RMD) has undertaken projects in the oil sands area to collect and chemically analyse rainfall on an event basis. The primary objective of these projects has been to:

1. Quantify the ion concentration and insoluble/soluble metals present in the rainfall; and
2. Delineate any possible changes in the ionic characteristics and spatial distribution of wetfall deposition. In previous years, although collection and handling of the rain samples were done by other contractors in the area, RMD was responsible for

establishing the precipitation network and liaising with network operators, instructing them on proper collection procedures. However, due to time and personnel constraints, this became unfeasible. Accordingly, to effectively continue this project, technical assistance was required to:

a. establish the precipitation collection network and set up the appropriate equipment/instrumentation at all stations; and
b. liaise with the station operators, instructing them on proper rain sample collection and handling procedures.

Contractor: Mr. R. Olson
Funding: $8250.00

Evaluation, Analysis, and Assessment of Precipitation Chemistry Data in the Alberta Oil Sands Region

Since 1976, the Research Management Division has undertaken projects to extensively sample and chemically analyse the accumulated snowpack and rain collected on an event basis in the AOSERP area. These projects have primarily entailed the collection and chemical analyses of the samples. Although approximately five years of snowpack data and eight years of rain data have been collected, neither data set has been subjected to rigorous quality control, statistical analyses, and interpretation. The project would therefore expedite:

1. Quality control of the data to determine its accuracy and reliability; and
2. Statistical analysis of the data to document (a) the deposition patterns and spatial variability of wet deposition pollutant loading, particularly in relation to airmass trajectories, and (b) any trends in the concentration of ionic and particulate constituents of the precipitation.

Contractor: Mr. Ron Portelli, Concord Scientific Corporation
Funding: $55 000.00

Impacts of Air Pollutant Mixtures Characteristic of Oil Sands Operations on Forest Vegetation and Soils

The objective of this co-operative program with the Canadian Forestry Service is to examine the effects of aerial emissions characteristic of oil sands operations on forest vegetation and soils. The study includes both laboratory and field investigations to identify and quantify forest tree response to single and multiple exposures to acid forming pollutants.

The project, now in its ninth and final year, is an integral component of the departmental Acid Deposition Research Program.

Contractor: Dr. P.A. Addison, Environment Canada, Canadian Forestry Service, Northern Forest Research Centre

Funding: $19 000.00

Scientific Services Contract to AE Project RMD 80-13: Impacts of Air Pollutant Mixtures Characteristic of Oil Sands Operations on Forest Vegetation and Soils

The Contractor provides technical assistance in the preparation and analysis (biochemical and physiological) of plant material exposed to fumigation experiments. Assistance is also provided in the propagation of plant material to be used for experimental purposes.

Contractor: Mr. D. Huebert, Canadian Forestry Service, Northern Forest Research Centre

Funding: $21 000.00

International Symposium on Acidic Precipitation, Lake Rosseau, Muskoka, Ontario - 1985

The purpose of this conference, which was jointly sponsored by the federal and provincial governments of Canada, was to address the issue of environmental protection as it relates to acid precipitation. Original scientific presentations were given in the disciplines related to atmospheric transport, tranformation, and deposition of pollutants; the direct and indirect effects, including trace contaminants, on terrestrial and aquatic

ecosystems; and the socio-economic considerations of these effects. Symposia on special topics and poster sessions were also held.

Contractor: Mr. J.W. Giles, Ontario Ministry of the Environment

Funding: $8500.00

Investigation of Ion Imbalance in Precipitation Chemistry Analyses

Although the problem of ion imbalances in precipitation samples has been recognized by various researchers, only a minimal effort has been made to specifically quantify possible sources of the imbalance. This is of particular concern to RMD, as an ion imbalance has been quantified in summer precipitation samples collected in the oil sands region, and to a lesser degree in winter precipitation samples. The complete characterization of precipitation chemistry is essential to assess the potential acidification of the environment. The underlying causes of ion imbalances may relate to both physical and chemical factors; however, at this time the project will be directed toward examining only the effect of the following chemical factors on the ion imbalance:

1. The effect of analytical variability on each chemical element over the entire analytical range;
2. The quantification of other chemical species that may exist in the samples (e.g., organic acids and oxalates) and that may contribute significantly to the balance; and
3. The evaluation of techniques for measuring acidity and alkalinity.

Contractor: Mr. Don LaBerge, Analytical Services, CHEMEX Labs (Alberta) Ltd.

Funding: $10 000.00

Lease and Maintenance of a Radio Tower on the Sandalta Lease

This project covered the lease and installation charges for a 100-foot radio tower for the 12-month period 1984 April 01 to 1985 March 31. The tower was installed on a pre-determined site 450 feet from the Sandalta air quality trailer with a minimum 20-foot clearance above the tree canopy. Scientific and meteorological equipment was mounted on this tower to

facilitate collection of data for the RMD 83-01 "Dry Deposition of Sulphur Dioxide Study."
Contractor: Mr. Jim Pauls, Northwest Electronics
Funding: $2200.00

The Response of Vegetational Communities to Aerial Emissions - Permanent Sample Plots

This project is part of the public commitment of Alberta Environment for a biomonitoring program in the AOSERP region. The project will determine structural dynamics in the boreal forest to compare any natural changes to those induced by aerial emissions. Project results will be used in conjunction with findings from other studies to develop sensitive and predictive indicators of effects of aerial emissions on forest ecosystems (as an early warning). The study will involve process-related phenomena and will establish the relationship between changes occurring in these processes and the structure and function of the terrestrial ecosystem.

This project is an integral component of the departmental Acid Deposition Research Program.
Contractor: G. LaRoi, Department of Botany, University of Alberta
Funding: $79 600.00

16th International Air Pollution Workshop, Banff Park Lodge, Banff, Alberta, 1984 April 30 - May 04

The Air Pollution Workshop is an annual forum for the presentation and discussion of issues regarding the effects of air quality on agricultural crops and natural ecosystems. The 16th International Air Pollution Workshop was a first for Western Canada. Members from government, industry, and the academic community convened to discuss and exchange ideas on current and future air pollution issues.
Contractor: A.H. Legge, Kananaskis Centre for Environmental Research
Funding: $2500.00

PUBLICATIONS

Bottenheim, J.W. 1984. Plume chemistry studies during 1980 in the Athabasca Tar Sands region. Prep. for Alberta Environment, Research Management Division by Atmospheric Dispersion Division, Atmospheric Environment Service. RMD Report OF-80. 259 pp.

Canadian Forestry Service. 1983. Canadian Forestry Service toxic substances project NOR-7-182: annual report. Prep. for Alberta Environment, Research Management Division by Canadian Forestry Service. RMD Report OF-67. 244 pp.

Cheng, L., D. Rogers, A. Davis, E. Peake, and K.L. Grandia. 1984. Aircraft observations of snowfall from a synthetic crude oil plant plume. Presented at the Fourth Joint Conference on Applications of Air Pollution Meteorology. 1984 October 16-19; Portland, Oregon; 4 pp.

Jamal, A.H., D.S. Chadder, W.A. Murray, and R.D. Brymer. 1985. Dry deposition of sulphur dioxide in the Athabasca Oil Sands area. Prep. for Alberta Environment, Research Management Division by Promet Environmental Group Ltd. RMD Report OF-87. 37 pp.

Leahey, D.M. and M.C. Hansen. 1984. Meteorological evidence of greater dispersion of elevated plumes: implications for acid deposition. Paper presented at the 21st Annual Meeting of PNWIS/APCA, 1984 November 12-14; Portland, Oregon; 10 pp.

Leahey, D.M. and M.C. Hansen. 1985. Meteorological evidence for greater dispersion of elevated plumes. Journal of Air Pollution Control Association 35(8):828-830.

Legge, A.H., H.C. Kaufmann, and J.W. Winchester. 1984. Tree-ring analysis by PIXE for a historical record of soil chemistry response to acidic air pollution. Nuclear Instruments and Methods in Physics Research B3(1984):507-510 (North-Holland, Amsterdam).

Nyborg, M., R.W. Parker, S. Takyi, and P. Yeung. 1985. Deposition of sulphur and its influence on soils in the AOSERP study area. Prep. for Alberta Environment, Research Management Division by Soils Department, University of Alberta. RMD Report L-86. 153 pp.

AIR QUALITY/CLIMATE RESEARCH PROGRAM

Pollutant emissions and their secondary or tertiary reaction products are important contributors to the degradation of urban air quality. In recent public surveys, air quality has been identified as a leading environmental concern in Alberta: the issue ranked fourth in 1981 and first in 1982 and 1983. The variety of sources contributing to urban air pollution makes it difficult to understand and control air pollution. This is compounded by the fact that at or near ground level, the concentrations of pollutants are a function of meteorological conditions and emissions parameters, which vary both in time and space. Nonetheless, because of the potential ramifications for air quality and human health, the Air Quality Subprogram is designed to quantitatively and qualitatively:

1. Characterize urban air quality; and
2. Understand and delineate the consequences of poor urban air quality.

The effects of enhanced climate variability and change on the environment have become a concern nationally and internationally. The potential ramifications of such aberrations for Alberta are not fully known. The Climate Subprogram will be designed to optimize the use of climate information to examine probable climatic effects on the environment. This subprogram will be supportive and complementary to the Canadian Climate Program as recommended by the Canadian Council of Resource and Environment Ministers (CCREM). The department provides the lead role and chairs the Alberta Climate Advisory Committee.

PROJECTS

Selection and Applications of an Urban Air Quality Model for Alberta

The efficient management of urban air resources and the planning and design of environmental legislation, impact assessments, and land use planning requires a comprehensive air quality assessment. This necessitates an understanding of the quantitative relationships between urban emissions, background air quality, atmospheric transport, photochemical reactions, ambient concentrations, and their probable effects. Existing urban air quality models developed for Alberta, however, have investigated only particular components of air quality, such as chemical and physical processes and dispersion, rather than taking an overall integrated approach. This project will identify and review available urban air quality models with respect to:

1. The underlying theoretical assumptions used to derive the models;
2. The input parameters required to drive the models; and
3. How adequately the models address chemical reactions, transport, and dispersion.

Recommendations will be made regarding the suitability and applicability of the models to Alberta. An appropriate model or models will then be selected, adapted, and validated for use in Alberta.

Contractor: Mr. Ron Portelli, Concord Scientific Corporation
Funding: $50 000.00

Synthesis and Assessment of Urban Air Quality Research - Update

To facilitate the development of the Urban Air Quality Research Program, ESL, Environmental Science Limited was contracted to synthesize available information pertaining to urban air quality research in Alberta and review it in the context of national/international research activities. Although every attempt was made to glean all pertinent reports and papers via literature searches, subsequent scientific reviews revealed that some relevant documents were omitted.

It is critical that all literature pertinent to urban air quality research in Alberta be synthesized and incorporated into the report to ensure

that not only is the report credible, but also that a relevant and accurate research program is developed. The purpose of this contract is to ensure that all documents/literature are contained in the final report.

Contractor: T. Jandali, ESL, Environmental Sciences Limited

Funding: $6000.00

PUBLICATIONS

Colley, D.G., R.W. Poon, M.J. Zelensky, and L. Zanzotto. 1984. Alberta oxides of nitrogen emissions forecast 1980 to 2000. Paper presented at the Canadian Prairie and Northern Chapter of PNWIS/APCA Annual Meeting 1984 May 15; Edmonton, Alberta; 10 pp.

Gourlay, P. 1985. An overview of solar radiation collection and applications in Alberta. Prep. for Alberta Environment, Research Management Division. RMD Report L-88. 23 pp.

Leahey, D.M. and M.C. Hansen. 1984. Meteorological evidence for greater dispersion of elevated plumes: implications for acid deposition. Paper presented at the 21st Annual Meeting of PNWIS/APCA, 1984 November 12 -14; Portland, Oregon; 10 pp.

Leahey, D.M., H.G. Paskall, M.B. Schroeder, and M.J. Zelensky. 1985. A preliminary study of the chemical composition and combustion efficiency of a sour gas flare. Prep. for Alberta Environment, Research Management Division by Western Research, Division of Bow Valley Resource Services Ltd. RMD Report 85/30. 93 pp.

Leahey, D.M. and M.C. Hansen. 1985. Doppler acoustic radar observations of wind in the Ellerslie region of Alberta. Prep. for Alberta Environment, Research Management Division by Western Research, Division of Bow Valley Resources Services Ltd. RMD Report 85/31. 77 pp.

Leahey, D.M. and M.J.E. Davies. 1984. Observations of plume rise from sour gas flares. Atmospheric Environment 18(5):917-922.

Mathews, T. and R.B. Hicks. 1984. Doppler sodar measurement of wind climatology of Calgary. Prep. for Alberta Environment, Research Management Division by Department of Physics, University of Calgary. RMD Report 84/28. 149 pp.

Rudolph, R.C. and D.S. Davison. 1985. Estimates of roughness length from minisonde profiles in the Athabasca Oil Sands area. Prep. for Alberta Environment, Research Management Division by INTERA Technologies Ltd. RMD Report L-87. 42 pp.

ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM (AOSERP)

The Alberta Oil Sands Environmental Research Program (AOSERP) was implemented in 1975 to direct and co-ordinate research projects concerned with the environmental effects of development of the Athabasca Oil Sands in Alberta.

Following a review of the program in 1980, the study parameters were broadened to include the investigation of the effects of in situ development in all heavy oil and oil sands areas of the province, notably in the Cold Lake region. Also in 1980 the administration of AOSERP and the management of the research conducted under the auspices of the program were amalgamated with the research responsibilities of the Research Secretariat of Alberta Environment, and the Research Management Division (RMD) was formed.

As noted in the introduction to this report, the AOSERP projects have been listed under the major program areas of RMD to which they belong. Following is a summary of the projects by major program for the 1984/85 fiscal year:

Acid Deposition

1. RMD 80-13: Impacts of Air Pollutant Mixtures Characteristic of Oil Sands Operations on Forest Vegetation and Soils;
2. RMD 81-54: Chemical Analysis of Summer Precipitation in the Oil Sands Area;
3. RMD 81-54A: Establishment of a Summer Precipitation Collection Network in the Oil Sands Area;
4. RMD 81-54B: Investigation of Ion Imbalance in Precipitation Chemistry Analyses;
5. RMD 82-08: Determination of Dispersion, Pollutant Trajectories, Precipitation-Acidifying Processes and Deposition Rates through Aircraft Measurements in the AOSERP Region - Phase III;
6. RMD 82-20: Air Quality Data Acquisition - Sandalta Air Quality Trailer;
7. RMD 83-01A: Lease and Maintenance of a Radio Tower on the Sandalta Lease;
8. RMD 83-01B: Dry Deposition of Sulphur Dioxide in the Athabasca Oil Sands Area;

9. RMD 83-03: Effects of Deposition of Acid Forming Substances on Organic Matter Decomposition/Nutrient Cycling in a Forest Ecosystem;
10. RMD 83-26A: Atmosphere-Biosphere Interface: Verification of the Model to Determine the Frequency Distribution of SO_2 Ground Level Concentrations;
11. RMD 83-26B: Atmosphere-Biosphere Interface: Application of a Numerical Model to Assess Growth Response of Jackpine to Chronic Atmospheric SO_2 Exposures;
12. RMD 84-07: Development of an Acid Deposition Research Program for Alberta Environment, Research Management Division; and
13. RMD 84-16: Evaluation, Analysis, and Assessment of Snowpack and Precipitation Data from a Monitoring Network in the AOSERP Area.

Reclamation

1. RMD 81-15: Northeast Soil Reconstruction Program: Reinstatement of Mycorrhizal Potential in Reconstructed Soils; and
2. RMD 83-07: Northeast Soil Reconstruction Program: Oil Sands Tailings Soil Reconstruction Project.

Administration

1. RMD 80-14: Mildred Lake Camp Catering.

A separate fiscal year review of activities is published for the Alberta Oil Sands Environmental Research Program and is available from the Research Management Division.

PUBLICATIONS

Bliss, L.C., ed. 1985. Long-term prediction of vegetation performance on mined sands. Interim report 1976 to 1977. Prep. for Alberta Environment, Research Management Division by Department of Botany, University of Alberta. RMD Report OF-81. 272 pp.

Bliss, L.C. and J.M. Mayo. 1985. An ecophysiological investigation of the jackpine woodland with reference to revegetation of mined sands. Prep. for Alberta Environment, Research Management Division by L.C. Bliss (Department of Botany, University of Wasnington) and J.M. Mayo (University of Alberta). RMD Report OF-83. 124 pp.

Bottenheim, J.W. 1984. Plume chemistry studies during 1980 in the Athabasca Tar Sands region. Prep. for Alberta Environment, Research Management Division by Atmospheric Dispersion Division, Atmospheric Environment Service. RMD Report OF-80. 259 pp.

Canadian Forestry Service. 1983. Canadian Forestry Service toxic substances project NOR-7-182: annual report. Prep. for Alberta Environment, Research Management Division by Canadian Forestry Service. RMD Report OF-67. 244 pp.

Cheng, L., D. Rogers, A. Davis, E. Peake, and K.L. Grandia. 1984. Aircraft observations of snowfall from a synthetic crude oil plant plume. Presented at the Fourth Joint Conference on Applications of Air Pollution Meteorology. 1984 October 16-19; Portland, Oregon; 4 pp.

Corkum, L. 1985. Water quality of the Athabasca Oil Sands area: a regional study. Prep. for Alberta Environment, Research Management Division by Water Quality Branch, Pollution Control Division. RMD Report L-85. 273 pp.

Jamal, A.H., D.S. Chadder, W.A. Murray, and R.D. Brymer. 1985. Dry deposition of sulphur dioxide in the Athabasca Oil Sands area. Prep. for Alberta Environment, Research Management Division by Promet Environmental Group Ltd. RMD Report OF-87. 37 pp.

Leahey, D.M. and M.C. Hansen. 1984. Meteorological evidence of greater dispersion of elevated plumes: implications for acid deposition. Paper presented at the 21st Annual Meeting of PNWIS/APCA, 1984 November 12-14; Portland, Oregon; 10 pp.

Leahey, D.M. and M.J.E. Davies. 1984. Observations of plume rise from sour gas flares. Atmospheric Environment 18(5):917-922.

Legge, A.H., H.C. Kaufmann, and J.W. Winchester. 1984. Tree-ring analysis by PIXE for a historical record of soil chemistry response to acidic air pollution. Nuclear Instruments and Methods in Physics Research B3(1984):507-510 (North-Holland, Amsterdam).

Nyborg, M., R.W. Parker, S. Takyi, and P. Yeung. 1985. Deposition of sulphur and its influence on soils in the AOSERP study area. Prep. for Alberta Environment, Research Management Division by Soils Department, University of Alberta. RMD Report L-86. 153 pp.

Parkinson, D., ed. 1984. Mycorrhizal studies regarding the reclamation of oil sand tailings: production and outplanting of jack pine seedlings and amounts of VA- and ectomycorrhizal inoculum stockpiled peat. Prep. for Alberta Environment, Research Management Division. RMD Report OF-70. 131 pp.

Rudolph, R.C. and D.S. Davison. 1985. Estimates of roughness length from minisonde profiles in the Athabasca Oil Sands Area. Prep. for Alberta Environment, Research Management Division by INTERA Technologies Ltd. RMD Report L-87. 42 pp.

ENVIRONMENTAL CONTAMINANTS RESEARCH PROGRAM

The Environmental Contaminants Research Program has been restricted in scope to addressing only the area of specific contaminants. The objectives of the program are:

1. To develop a mechanism for the identification and determination of priority of specific contaminants of concern to Alberta; and
2. To develop a mechanism for the accumulation of data relative to the fate and effects of specific contaminants in the environment.

Of specific concern are water quality issues associated with the construction of new reservoirs and the potential contaminants produced by in situ oil extraction. To facilitate co-operation and co-ordination, the major projects are reviewed and supported by agencies such as the Alberta Research Council (ARC), the Alberta Oil Sands Technology and Research Authority (AOSTRA), the Alberta Environmental Centre (AEC), Environment Canada, and industry.

PROJECTS

Mechanisms Controlling the Return of Nutrients from the Sediments of Shallow Productive Lakes in Alberta

The objective of this project is to identify factors controlling the rate of sediment release of phosphorus in shallow Alberta lakes by examining the effect of thermal structure and productivity on the rates of phosphorus release. High phosphorus levels in lake water cause eutrophication, a major problem facing lakes in the province. An understanding of the mechanisms controlling phosphorus release from sediments has implications for lake management in Alberta and complements several projects undertaken in 1981 by the Water Quality Section of Alberta Environment, and may assist in the solution of eutrophication-related problems in Lake Wabamun.

Contractor: Dr. E.E. Prepas, Department of Zoology, University of Alberta
Funding: $20 000.00 (Research Management Division)

Seasonal Dynamics of Phosphorus Partitioning and Export in Two Headwater Streams in Central Alberta

Funding was provided by Alberta Environment (RMD) to a graduate student at the University of Alberta for two years ($10 000 in 1983/84 and $7000.00 in 1984/85). The objective of this project was to develop a model to predict how seasonal changes will influence phosphorus loadings in flowing water. This was accomplished by testing for temporal variation in phosphorus concentration and partitioning in two headwater streams flowing through soft rocks or glacial till in undisturbed forest watersheds.

Contractor: Dr. E.E. Prepas, Department of Zoology, University of Alberta
Funding: $7000.00 (Research Management Division)

Surface Water Contamination from Sanitary Landfills

The operation of landfills, in particular the Clover Bar and Forest Lawn landfills, is of concern to the Waste Management Branch of Alberta Environment. In both landfills, leachates are escaping to the environment and entering either surface or groundwaters. The study will identify the priority

pollutants (chemicals of concern) in the leachates and assess their potential environmental hazard.

Contractor: Dr. B.L. Baker, Kananaskis Centre for Environmental Research, University of Calgary

Funding: $16 450.00 (Research Management Division)

PUBLICATIONS

Finch, G. 1985. Effect of chemical coagulation on the removal of fecal coliforms from a seasonal discharge sewage lagoon. RMD Report OF-78. 139 pp. (M.Sc. thesis for Department of Civil Engineering, University of Alberta.)

Wallis, P.M., D.L. Lehmann, D.A. MacMillan, and J.M. Buchanan-Mappin. 1984. Sludge application to land compared with a pasture and a hayfield: reduction of biological hazard over time. Journal of Environmental Quality 13(4):645-650.

ENVIRONMENTAL EMERGENCIES AND RISK ASSESSMENT RESEARCH PROGRAM

The uncontrolled release of environmental pollutants presents a serious concern to the public. The Environmental Emergencies and Risk Assessment Research Program will identify departmental research needs to minimize possible emergency situations and provide a means for identifying, analysing, interpreting, and evaluating all significant risks within Alberta. The program, which is currently in the developmental stage, will provide scientifically validated strategies for integrated environmental protection.

There were no projects funded under this program in 1984/85.

ENVIRONMENTAL INFORMATION RESEARCH PROGRAM

This program is currently being reviewed by the Research Management Division in an effort to reduce the overall number of programs and to integrate the research activity under this program with other divisionally managed programs. Up until its most recent operational year (1983/84), the program included two types of research activity:

1. Public perception research - identifying environmental issues of public concern to provide important feedback regarding departmental policies and their effectiveness on public perceptions; and
2. Translation of results from all research areas - to produce policy-relevant alternatives so that information gathered through public perception research is made meaningful for decision-makers.

There were no projects funded under this program in 1984/85.

PUBLICATIONS

Kennedy, L.W. and N. Mehra. 1984. Edmonton area study. Booklet produced by Population Research Laboratory, Department of Sociology, The University of Alberta.

GEOSCIENCE RESEARCH PROGRAM

The Geoscience Research Program was developed to co-ordinate research in the areas of natural resource development and land use and the impacts of their exploitation on the environment. Research in geology, geophysics, civil engineering, and soil sciences is covered by this program.

This program is intended to provide scientific information on which to base land use decisions, and will contribute to the establishment of long-term policies to ensure that Alberta's natural resources are used in an efficient and responsible manner.

PROJECTS

Review and Comment on the Report Entitled: "Monitoring the South Peak of Turtle Mountain, 1980-1984"

The project provided funds for the scientific review and comment by a scientist outside the department on the report entitled "Monitoring the South Peak of Turtle Mountain, 1980-1984."

Contractor: Dr. N. Morgenstern

Funding: $250.00 (Research Management Division)

Turtle Mountain Meteorological Data Summary

This is the final stage of the Turtle Mountain weather station project, which is one in a series of projects designed to determine if a mass of rock on the South Peak of Turtle Mountain is in motion and therefore likely to slide into the Crowsnest Valley in the future.

The weather station, which is installed on the mountain peak, currently records hourly observations of eight meteorological parameters. These data will be used to establish a climatological data base and to support concurrent monitoring projects.

The project entails archiving all data on the MTS system, generating monthly reporting forms to summarize the data, and designing interactive data analysis programs. These will allow members of the Turtle Mountain study team to access and manipulate specific pieces of data that are related to the other projects.

Contractor: Ms. Donna Yurko

Funding: $3500.00 (Research Management Division)

PUBLICATIONS

Biberhofer, H. 1984. Turtle Mountain study archive inventory. Prep. for Alberta Environment, Research Management Division by Earth Sciences Division. RMD Report OF-74. 325 pp.

RECLAMATION RESEARCH PROGRAM

Reclamation research funded by Alberta Environment is co-ordinated by the Reclamation Research Co-ordinating Committee, which is chaired by the Research Management Division. In the province, land disturbed by large-scale surface mining operations must be returned to equal or better productivity. The Reclamation Research Program is designed to identify methods that will make the reclamation process more efficient and effective. Research is centred on

1. Determining methods of rebuilding productive soils (physically, chemically, and biologically);
2. Identifying changes in the quantity and quality of surface water and groundwater following disturbance and reclamation;
3. Developing native plant species for reclamation;
4. Controlling erosion; and
5. Improving materials-handling operations.

Recommendations arising from the program will be used to refine the government's Development and Reclamation Guidelines.

The Chairman of the Departmental Committee assumes managerial and administrative responsibilities for reclamation research in association with the interdepartmental Reclamation Research Technical Advisory Committee (RRTAC). In 1984/85, RRTAC committed approximately $1.2 million to a Reclamation Research Program. Funding for RRTAC projects is through the Heritage Savings Trust Fund (HSTF).

Program direction is determined by an interdepartmental committee with members from the Alberta government departments of Agriculture, Energy and Natural Resources, and Environment, and the Alberta Research Council. Direction of projects and sub-programs in three biophysical regions (Plains, Mountains and Foothills, and Northeast Alberta) is co-ordinated by government/industry committees.

PROJECTS

Assessment of Reclamation Potential and Hydrological Impact of Large-Scale Surface Mining in Plains Areas of Alberta

The main objective of this project is to develop a thorough understanding of the materials present and the hydrologic and geologic processes acting within the landscape so that the results of various surface landform and materials placement designs can be assessed with reference to potential land use options following mining.

Contractor: Dr. S.R. Moran, Natural Resources Division, Alberta Research Council

Funding: $958 528.00 (Alberta Heritage Savings Trust Fund)

Battle River Soil Reconstruction Project

The objectives of this study are:

1. To determine the required depth of soil placement over sodic mine spoil to ensure that mined land, particularly in the Battle River Coal Field, meets reclamation objectives;
2. To develop methods of sustaining re-established productivity, with emphasis on controlling salt movement from mine spoil into the reconstructed root zone; and
3. To develop treatments that will minimize soil quantities needed to restore the original productivity of the land.

Contractor: Mr. L.A. Leskiw, Pedology Consultants, Land Resource Sciences

Funding: $140 000.00 (Alberta Heritage Savings Trust Fund)

Bottom Ash Amendment of Orphaned Sodic Soil

This study is designed to:

1. Determine the best rate and method of bottom ash application to sodic spoil as related to crop yield and trafficability;
2. Compare application rate and method effects on physical and chemical soil parameters;

3. Monitor changes in ash and spoil over time; and
4. Compare growth between areas with and without bottom ash.

Contractor: Ms. S. Landsburg
Funding: $13 408.00 (Alberta Heritage Savings Trust Fund)

Bottom Ash Plots: Samples

This subproject consists of a number of various soil and plant sample analyses. It falls under the direction of Ms. S. Landsburg as a portion of her project "Bottom Ash Amendment of Orphaned Sodic Soils."
Contractor: Mr. J. Crepin, Norwest Soil Research Inc.
Funding: $9000.00 (Alberta Heritage Savings Trust Fund)

Bottom Ash Plots: Harvesting

This subproject consists of the harvesting of forage crops from 42 bottom ash plots. It falls under the direction of Ms. S. Landsburg as a portion of her project "Bottom Ash Amendment of Orphaned Sodic Soils."
Contractor: Mr. A. Twardy, Pedology Consultants
Funding: $2000.00 (Alberta Heritage Savings Trust Fund)

Growth Performance of Commercial Timber Species

The purpose of this study is to review and report from all available literature growth performance data that could be used to develop standards expected of commercial timber tree species for reclaimed lands in the Eastern Slopes area of Alberta.
Contractor: Mr. W.R. Dempster, W.R. Dempster and Associates Ltd.
Funding: $29 950.00 ($14 975.00 RRTAC; $14 975.00 Coal Association of Canada)

Highvale Soil Reconstruction Project

The objectives of this study are:

1. To determine the required depth of soil replacement over sodic mine spoil to ensure that mined land, particularly in the Highvale Mine Permit Area, meets reclamation objectives;

2. To assess the sustainability of re-established productivity with emphasis on monitoring salt movement from mine spoil into the reconstructed root zone; and
3. To examine the effects of slope aspect and slope steepness on water movement, salt movement, and productivity.

Contractor: Mr. L.A. Panek, Monenco Consultants Ltd.

Funding: $126 429.00 (Alberta Heritage Savings Trust Fund)

Oil Sands Tailings Soil Reconstruction Project

The objective of this project is to identify methods of constructing soils from tailings sand, peat, and clay materials that will:

1. Support desired initial vegetation cover; and
2. Evolve over time and in response to the forces of pedogenesis in the oil sands region into a soil capable of supporting a maintenance-free forest at the desired level of productivity.

The study will also determine the effect of soil variables on woody plant performance (survival and growth), long- and short-term stability, and survival of the soil/plant system in reconstructed soils.

This project is an integral component of the Alberta Oil Sands Environmental Research Program (AOSERP).

Contractor: Mr. H.E. Martens, Reclamation Planning and Research, Environmental Design, Hardy Associates (1978) Limited

Funding: $94 000.00 ($47 000.00 RRTAC; $47 000.00 Syncrude, Suncor, and the Oil Sands Industry Environmental Association)

Reinstatement of Mycorrhizal Potential in Reconstructed Soils

Mycorrhizal fungi are very important to the nutrition of trees. This project will determine the survival and inoculum potential of mycorrhizal fungi in undisturbed and reconstructed soil to be used in oil sands tailings reclamation. Also, fungal species will be selected for use in jack pine inoculation programs and mycorrhizal development will be monitored in field trials.

This project is an integral component of the Alberta Oil Sands Environmental Research Program (AOSERP).

Contractor: Dr. D. Parkinson, Kananaskis Centre for Environmental Research, University of Calgary

Funding: $89 235.00 (Alberta Heritage Savings Trust Fund)

Settling Pond Sizing and Design - Phase I

This project will include a critical review of settling pond design literature and an evaluation of possible alternatives to sediment removal by ponding. The result of this review will be a catalogue of available design procedures that will characterize the strengths and weaknesses of each method, particularly with respect to environmental conditions found in the Alberta foothills and front ranges.

Contractor: Dr. A.H. Somani, Monenco Consultants Limited

Funding: $38 800.00 ($19 400.00 RRTAC; $19 400.00 Coal Association of Canada)

Soil Reconstruction in Mountains and Foothills

The primary aim of the project is to assemble available information to enable operational reclamation decisions to be made, where possible, to meet three reclamation objectives:

1. Tree growth (forestry),
2. Shrub growth (wildlife), and
3. Herbaceous cover (erosion control).

The review will also determine the information gaps and recommend needed research.

Given that operational costs of reclamation are often very high, the review will attempt to determine how to undertake reclamation at the lowest possible cost.

Contractor: Mr. Len Knapik, Pedocan Land Evaluation Ltd.

Funding: $49 550.00 ($24 775.00 RRTAC; $24 775.00 Coal Association of Canada)

Waste Dump Design for Erosion Control

The study follows up work begun in 1982 for RRTAC related to the design of mountain/foothills coal mine waste dumps, where the slopes that were being achieved on free and resloped dumps were defined. The objectives of this erosion study are to examine surface stability and erosion control as a function of dump design (i.e., terrace height and width, slope length and angle). The knowledge generated will be useful in determining practical guidelines for waste dump reclamation and design.

Contractor: Mr. R.G. Chopiuk, Coal Mining Research Centre

Funding: $41 290.00 (Alberta Heritage Savings Trust Fund)

Wildlife Habitat Reclamation Research

Within the foothills and mountain biomes of Alberta, exploratory and extractive activities by the petroleum, mining, and forestry industries have resulted in the disturbance of associated lands, with subsequent reduction in the availability and quality of wildlife habitat. Because of habitat loss in these biomes, there is a need to consolidate information on wildlife habitat reclamation and enhancement methods and to determine the applicability of these methods to Alberta, as well as to develop criteria for the assessment of wildlife habitat reclamation procedures for certification purposes.

Contractor: Mr. Jeff Green, LGL Limited

Funding: $29 440.00 ($14 720.00 RRTAC; $14 720.00 Coal Association of Canada)

PUBLICATIONS

Bliss, L.C., ed. 1985. Long-term prediction of vegetation performance on mined sands. Interim report 1976 to 1977. Prep. for Alberta Environment, Research Management Division by Department of Botany, University of Alberta. RMD Report OF-81. 272 pp.

Bliss, L.C. and J.M. Mayo. 1985. An ecophysiological investigation of the jackpine woodland with reference to revegetation of mined sands. Prep. for Alberta Environment, Research Management Division by L.C. Bliss (Department of Botany, University of Washington) and J.M. Mayo (Department of Botany, University of Alberta). RMD Report OF-83. 124 pp.

Danielson, R.M. 1984. Ectomycorrhizal associations in jack pine stands in northeastern Alberta. Canadian Journal of Botany 62(5)932-939.

Danielson, R.M. 1985. Mycorrhizae and reclamation of stressed terrestrial environments. IN Soil reclamation processes: Microbiological analysis and applications 6:173-201. R.L. Tate III and D.A. Klein, eds. Marcel Dekker, Inc., New York, NY. 349 pp.

Danielson, R.M., S. Visser, and D. Parkinson. 1984. Production of ecto-mycorrhizae on container-grown jack pine seedlings. Canadian Journal of Forestry Research 14(1):33-36.

Danielson, R.M., S. Visser, and D. Parkinson. 1984. The effectiveness of mycelial slurries of mycorrhizal fungi for the inoculation of container-grown jack pine seedlings. Canadian Journal of Forestry Research 14(1):140-142.

Parkinson, D., ed. 1984. Mycorrhizal studies regarding the reclamation of oil sand tailings: production and outplanting of jack pine seedlings and amounts of VA- and ectomycorrhizal inoculum stockpiled peat. Prep. for Alberta Environment, Research Management Division. RMD Report OF-70. 131 pp.

Parkinson, D., R.M. Danielson, C. Griffiths, S. Visser, and J.C. Zak. 1984. Soil microbiology in land reclamation (2 vols.). Prep. for the Alberta Land Conservation Council, Reclamation Research Technical Advisory Committee. Edmonton, Alberta. Report RRTAC 84-4. 676 pp.

Ross, Michael S. and George H. LaRoi. 1985. Structural dynamics of boreal forest ecosystems on three habitat types in the Hondo-Lesser Slave Lake area of north central Alberta in 1983. Prep. for Alberta Environment, Research Management Division by Department of Botany, University of Alberta. RMD Report OF-79. 147 pp.

Visser, S. 1985. Management of microbial processes in surface mined land reclamation in Western Canada. IN Soil reclamation processes: Microbiological analysis and applications 7:203-241. R.L. Tate III and D.A. Klein, eds. Published by Marcel Dekker, Inc., New York, NY. 349 pp.

Ziemkiewicz, P.F., ed. Proceedings: Revegetation methods for Alberta's mountains and foothills. Edmonton, Alberta; 1984 April 30 to May 01. Alberta Land Conservation Council, Reclamation Research Technical Advisory Committee. Report RRTAC 85-1. 416 pp.

WATER AND WASTE MANAGEMENT RESEARCH PROGRAM

The Water and Waste Management Research Program has been developed to focus on research that improves our understanding of management principles and the water/waste interface with specific emphasis on co-ordinating all such research that is conducted in Alberta or is of particular interest to Albertans.

Prime objectives of the program are to undertake co-operative research, to address the concerns and issues of the public, and to undertake specific technology development projects for water and waste treatment. Projects that qualify for support deal with:

1. Legislative and enforcement policy matters;
2. Land use and facility siting; and
3. Technical matters, including:
    a. incineration,
    b. tail gas scrubbing,
    c. oil sands tailings,
    d. water, waste, and wastewater treatment and recycling,
    e. waste handling, and
    f. reclamation of disposal sites.

The program and the projects serve to complement the mandates and operations of the department and other provincial agencies.

PROJECTS

Attenuation of Pollutants by Alberta Soils

This study is concerned with the determination of the attenuation of a series of hazardous materials by Alberta soils. Many substances discarded into landfills are liquid and mobile, and pass through many different environments. They are accompanied by a wide array of chemical, biological, and physical characteristics. In contact with soils, they become tied up. This study will examine the ability of various types of Alberta soils to attenuate a number of hazardous liquids by adding aliquots of the liquids to columns containing different soils.

Contractor: B.L. Baker, Kananaskis Centre for Environmental Research, University of Calgary

Funding: $21 964.00 (Research Management Division)

Development of a Procedure to Nondestructively Evaluate the Fusion Quality of Geomembrane Seams

High density polyethylene (HDPE) and other polymeric membranes are being used increasingly as impermeable barriers in waste and hazardous fluid surface storage facilities. It is essential that the integrity of the field-prepared seams be assured to avoid leaks developing once the facility becomes operational.

Mechanical tests in samples removed from the seams are used to assess the general quality of the seams, but such sampling procedures cannot confirm the complete integrity of the seam. A nondestructive method of evaluating 100% of the field-prepared seam for lack of fusion is desirable.

The geometry of the seam makes it suitable for inspection by ultrasonic techniques, provided the appropriate equipment can be packaged in a field-hardened unit and is able to detect defective regions at an appropriate speed.

The objectives of this project are:

1. To develop and test an ultrasonic inspection system for geomembrane seams; and
2. To develop the procedure and criteria for its use.

Contractor: Dr. Ian D. Peggs, Hanson Materials Engineering (Western) Ltd.
Funding: $12 500.00 (Research Management Division)

Methodology Development for Giardia Analysis

Recent work has shown that the levels of infection for *Giardia* in wild domestic animals in Alberta averages about 10%. Many of these animals have the potential to introduce cysts that may be pathogenic to humans into water supplies. Good progress has been made in the detection and recovery of cysts in water supplies, but the human pathogenicity of such cysts remains undetermined. This project is directed toward applying existing identification methods to *Giardia* isolated from water supplies as the samples become available, and developing new methods of identification. If successful, the results from this project will provide the information and methodology necessary to respond definitely to suspected waterborne outbreaks of giardiasis by confirming the presence of cysts.
Contractor: Dr. P.M. Wallis, Kananaskis Centre for Environmental Research
Funding: $30 063.00 (Research Management Division)

Pilot Studies in the Use of Ozone for Domestic Water Treatment

This project is designed as a three-year graduate student project that will investigate the feasibility of using ozone in the treatment of domestic water as an alternative to chlorination. The study will involve the construction and operation of a pilot plant at The City of Calgary Glenmore Water Treatment Facility. The pilot plant will operate for one full year. During the year of operation, particular attention will be paid to contractor design effects, reaction kinetics, reaction products, and microbial inactivation. Secondary effects on colloid stability, water aggressiveness, and persistence of ozone in backwash effluents will be measured. All results will be compared with those of the existing prechlorination facility.
Contractor: Dr. A. Badakshan, Chemical & Petroleum Engineering Department
Dr. E. Hargesheimer, Water Works, City of Calgary
Funding: $15 000.00 (Research Management Division)

The Use and Effects of Chemical Coagulants in Water and Wastewater Treatment: The Effect of Chemical Coagulation on Microorganism Removal in a Sewage Lagoon Prior to Spring Discharge

This study will determine the effect of chemical coagulation on microorganism removal in a sewage lagoon prior to spring discharge. One of the principal objectives of wastewater treatment is to reduce the number of indicator organisms released into the environment, as pathogenic organisms are related to the quantities as indicator bacteria. Various methods have been used to reduce the number of these organisms. In lagoon systems, retention time, temperature, and ultraviolet radiation play an important role in natural disinfection. The factors are of little importance during the winter months, hence spring discharges from lagoons potentially contain large numbers of pathogens. Microorganism chemical coagulation followed by sedimentation may remove large numbers of organisms. This project will determine optimum coagulation conditions by using laboratory experiments followed by full-scale application of the process in the spring of 1984. Analysis of the wastewater characteristics before and after treatment will provide some insight into the effectiveness of this low-cost approach. Some conclusions may be made regarding the mechanisms to relate the findings to operating experience in Calgary, where nutrient removal is practised.

Contractor: Dr. D.W. Smith, Department of Civil Engineering, University of Alberta

Funding: $7648.00 (Research Management Division)

PUBLICATIONS

Wallis, P.M. and J.M. Buchanan-Mappin. 1984. Reservoirs of Giardia spp. in southwestern Alberta. Journal of Wildlife Diseases 20(4):279-283.

Wallis, P.M. and J.M. Buchanan-Mappin. 1985. Detection of Giardia cysts at low concentrations in water using nucleopore membranes. Water Resources 19(3):331-334.

WATER RESOURCES RESEARCH PROGRAM

The Water Resources Research Program is designed to provide a focus for the measurement and evaluation of environmental trends and conditions in groundwater and surface water. Results of the research will provide the scientific support for Alberta Environment's regulations and guidelines, and will provide input in the management decision-making process.

Of significance is a major "Co-operative Program in Surface Water Engineering," jointly sponsored by the Alberta Research Council (ARC), Alberta Transportation, and Alberta Environment.

PROJECTS

Continuation of Study of Cold Lake Region Hydrogeology

The Cold Lake project, to date, has resulted in a good understanding of the natural steady state groundwater flow regime. This continuation will evaluate the perturbations to this natural flow regime that may result from in situ recovery of crude bitumen as well as possible effects due to deep well disposal.

Contractor: Dr. B. Hitchon, Natural Resources Division, Alberta Research Council

Funding: $99 867.00 (Research Management Division)

Control of Irrigation Return Flow in Southern Alberta

This project will investigate factors affecting the efficiency of irrigation water conveyance systems with the objective of increasing performance and reducing costs through improved structure designs, preventative controls, and management techniques. Two specific issues will be addressed:

1. The impact of aquatic weed infestations on the condition of the canal and its performance. This will involve cost-benefit analyses of various control measures.
2. The impact of farmer demand on the efficiency of the conveyance system. The effects of such factors as the frequency and magnitude of use, number of farmers on the canal, and methods of operation for delivery of the water will be examined.

Contractor: Mr. D. Manz, Civil Engineering Department, University of Calgary

Funding: $10 230.00 (Research Management Division)

Co-operative Program in Surface Water Engineering

This program is a continuation of joint research projects in fluvial mechanics and river engineering, surface water hydrology, sediment yield studies, ice formation, and break-up of streams. Projects within the program are sited throughout Alberta and are designed to investigate long-term, slowly changing, or randomly occurring hydrologic phenomena. Most of the processes

must be observed continuously over decade time scales. Individual studies are identified on the basis of their impact on public safety, protection of property, or a defined need for information to be used in the design of hydraulic structures. Information derived from the program is also used for enforcement of the Water Resources Act and Regulations.

The eight projects in this program address research priorities identified by the River Engineering Branch, Hydrology Branch, and Flow Forecasting Centre of the Technical Services Division of Alberta Environment. These priorities are:

1. Gauge surveys and data base development;
2. Freeze-up and break-up studies;
3. Scour surveys (to assess impacts of river processes such as scour, aggradation, and degradation on structures such as bridge piers and river training works);
4. Hydrology of small basins and culvert peak flows;
5. Sedimentation (to develop methods to predict sediment yield and transport and to investigate erosion control alternatives); and
6. Cohesive materials (to complete a state-of-the-art report on hydraulic erodibility of cohesive materials).

Contractor: Mr. Brian Shields and Dr. R.A. Harrington, Civil Engineering Department, Alberta Research Council

Funding: $150 000.00 (Research Management Division)

Dickson Dam Monitoring Project

The Dickson Dam Project is a co-operative venture of the Pollution Control Division (PCD), the Planning Division (PD), and the Research Management Division (RMD) of Alberta Environment, the Fish and Wildlife Divison of Energy and Natural Resources (ENR), and the Animal Sciences Wing of the Alberta Environmental Centre (AEC). The primary focus of the project in 1984/85 is to continue to examine the mercury levels in the reservoir (water, sediments, and biota). The overall goal is to provide understanding of the dynamics of the movement of mercury in recently constructed reservoirs in Alberta. The Dickson Dam project was initiated, funded, and built by Alberta Environment. Approval to construct the dam was based on the environmental

impact assessment (EIA) produced and submitted by Alberta Environment (Planning Division). Within the EIA a series of commitments to monitor the water quality of the reservoir and the water downstream were made. It was from these commitments that the research element was identified. That is, to collect data and conduct experiments to provide an understanding of changes in the water quality and the impact of those changes on the aquatic ecosystem as well as to provide information regarding the connection between the two. This program has involved active input from all of its sponsors. Preliminary data collection and literature reviews have been ongoing since 1980.

Contractor: Mr. E. Paleczny, Alberta Environmental Centre, and Mr. J. Babin, Pollution Control Division

Funding: $24 960.00 (Research Management Division)

The Effects of Salt Brine on the Performance of Compacted Clay Liners in Alberta

This project is based on a case history of a brine pond site near Redwater, Alberta. A comprehensive literature study will be followed by a detailed laboratory testing program. Undisturbed samples of brine-contaminated and uncontaminated clay liner materials will be tested for various hydraulic and geotechnical properties. The performance of brine-saturated compacted clay liners used for lining brine ponds will be assessed.

Contractor: Mr. B.H. Conlin, Komex Consultants Ltd.

Funding: $18 500.00 (Research Management Division)

Flatland Hydrology Simulation Model

In this graduate student project, a model will be developed that will maintain a spatially varied soil moisture budget for a flatland watershed. The concepts of potential and actual contributing area will be used to determine the depression storage losses, thereby allowing more accurate determination of the excess rainfall that will comprise runoff. Potential and actual contributing area relationships will be determined for a number of suitable prairie watersheds.

Contractor: Dr. J.P. Verschuren and Mr. J.M. Byrne, Department of Civil Engineering, University of Alberta

Funding: $15 000.00 (Research Management Division)

Modelling Snowmelt Infiltration to Frozen Prairie Soils

This project is a continuation of the project "Snowmelt Infiltration into Frozen Prairie Soils," which was successfully completed by 1984 March 31. The project is aimed at evaluating and testing the computer model developed under the first project by using field data from various watersheds in Saskatchewan and Alberta.

Contractor: Dr. D.M. Gray, Division of Hydrology, University of Saskatchewan

Funding: $9500.00 (Research Management Division)

Monitoring Groundwater Contribution to Water and Nutrient Budgets of Aquatic Systems in Alberta

Methods to measure the nutrient concentration of groundwater seepage into lakes will be developed and tested. Sampling strategies will be developed that can be applied to efficiently measure the groundwater nutrient loading.

Contractor: Dr. E.E. Prepas and Mr. R. Shaw, Department of Zoology, University of Alberta

Funding: $18 000.00 (Research Management Division)

PUBLICATIONS

Ashmore, P.E. 1985. Process and form in gravel-braided streams: laboratory modelling and field observations. RMD Report OF-84. 414 pp. (Ph.D. thesis for Department of Geography, University of Alberta.)

Babin, J. 1984. Winter oxygen depletion in temperate zone lakes. RMD Report OF-75. (M.Sc. thesis for Department of Zoology, University of Alberta.)

Babin, J. and E.E. Prepas. 1985. Modelling winter oxygen depletion rates in ice-covered temperate zone lakes in Canada. Canadian Journal of Fisheries and Aquatic Sciences 42(2):239-249.

Bierhuizen, J.F.H. and E.E. Prepas. 1985. Relationship between nutrients, dominant ions, and phytoplankton standing crop in prairie saline lakes. Canadian Journal of Fisheries and Aquatic Sciences 42(10):1588-1594.

Corkum, L. 1985. Water quality of the Athabasca Oil Sands area: a regional study. Prep. for Alberta Environment, Research Management Division by Water Quality Branch, Pollution Control Division. RMD Report L-85. 273 pp.

Hicks, F.E. 1985. Shear and velocity near a sloped bank in a curved channel. 126 pp. (M.Sc. thesis for Department of Civil Engineering, University of Alberta.)

Manz, D.H. Systems analysis of irrigation conveyance systems. RMD Report OF-86. 462 pp. (Ph.D. thesis for Department of Civil Engineering, University of Alberta.)

Munn, N.L. 1984. Temporal dynamics of phosphorus in two Alberta streams. RMD Report OF-77. 87 pp. (M.Sc. thesis for Department of Zoology, University of Alberta.)

Prepas, E.E. and J. Vickery. 1984. Seasonal changes in total phosphorus and the role of internal loading in Western Canadian lakes. Proceedings, International Association for Theoretical and Applied Limnology, France. Vol. 22:303-308.

Riley, E.T. 1984. Internal phosphorus loading from the sediments and the phosphorus-chlorophyll model in shallow lakes. RMD Report OF-76. 94 pp. (M.Sc. thesis for Department of Zoology, University of Alberta.)

Riley, E.T. and E.E. Prepas. 1984. Role of internal phosphorus loading in two shallow, productive lakes in Alberta, Canada. Canadian Journal of Fisheries and Aquatic Sciences 41(6):845-855.

Riley, E.T. and E.E. Prepas. 1985. Comparison of the phosphorus-chlorophyll relationships in mixed and stratified lakes. Canadian Journal of Fisheries and Aquatic Sciences 42(4):831-835.

Steffler, P.M. 1984. Turbulent flow in a curved rectangular channel. RMD Report OF-73. 262 pp. (Ph.D. thesis for Department of Civil Engineering, University of Alberta.)

COMMITTEES

Committees that have Research Management Division representation are listed below.

Departmental

Advisory Committee for the Research Study "Determination of the Source of Sulphate in Groundwater in the Lakeside Feedlot Area near Brooks, Alberta"

Alberta Watershed Research Program (AWRP)

Departmental Committee on Acid Deposition (DCAD)

Directors/Assistant Deputy Minister Environmental Protection Services Committee

Pulp and Paper Mill Effluents Committee

Reclamation Research Co-ordinating Committee (RRCC)

Interagency/Interdepartmental

Alberta Climate Advisory Committee (Alberta Environment)

Alberta Environmental Centre Technical Advisory Committee (AEC/TAC)

Alberta Environmental Research Trust Grants Advisory Committee (AERT-GAC)

Alberta Fishways (Alberta Environment, Alberta Energy and Natural Resources, Alberta Transportation, Environment Canada)

Alberta Government/Industry Acid Deposition Research Program (AGIADRP) Executive Committee

Alberta Government/Industry Acid Deposition Research Program (AGIADRP) Human Health Committee

Alberta Government/Industry Acid Deposition Research Program (AGIADRP) Medical Diagnostic Review Project Committee

Alberta Government/Industry Acid Deposition Research Program (AGIADRP) Members Committee

Associate Committee on Scientific Criteria for Environmental Quality (National Research Council)

Atmospheric Sciences Program Subcommittee (Alberta Research Council)

Canadian Annual Aquatic Toxicity Workshop Steering Committee (Alberta Environment, Alberta Environmental Centre, Environment Canada, Ontario Ministry of the Environment, University of Guelph, University of Alberta, University of British Columbia)

Canadian Climate Program Planning Board (Environment Canada)

Canadian Land Reclamation Association Executive Committee

Canadian Meteorological and Oceanographic Society (CMOS) Scientific Committee

Canadian Petroleum Association/Environmental Research Advisory Committee (CPA/ERAC)

Decommissioning Workshop (Alberta Environment, Environment Canada, Gouvernement du Québec Ministère de l'Environnement, PACE, CPA, CCPA, Ontario Ministry of Environment)

Dickson Dam Monitoring Committee (Alberta Environment, Alberta Environmental Centre, Alberta Energy and Natural Resources)

Environment Coordinating Committee (Canadian Council of Resource and Environment Ministers (CCREM))

Federal/Provincial Long-Range Transport of Atmospheric Pollutants (LRTAP) Acid Rain Research and Monitoring Co-ordinating Committee (RMCC), Atmospheric Sciences Group (Environment Canada)

Federal/Provincial Long-Range Transport of Atmospheric Pollutants (LRTAP) Acid Rain Steering Committee (Environment Canada)

Intergovernmental Aquatic Toxicity Group (Alberta Environment, Environment Canada, Ontario Ministry of the Environment)

International Symposium on Acidic Precipitation, Program Committee and Steering Committee (sponsored by the federal and provincial governments of Canada)

Kananaskis Centre Policy Advisory Committee (University of Calgary)

Long-Range Transport of Atmospheric Pollutants in Western Canada (LRTAP) Technical Committee (British Columbia, Alberta, Saskatchewan, Manitoba, Northwest Territories, and Canada)

Mountains and Foothills Reclamation Research Program (MFRRP) (Alberta Environment, Alberta Energy and Natural Resources, industry)

Mountains and Foothills Reclamation Research Program (MFRRP) Hydrology Subcommittee and Revegetation Subcommittee (Alberta Environment, Alberta Energy and Natural Resources, Esso Resources Ltd., Cardinal River Coal Mines, Luscar Ltd., Manalta Coal Ltd., Union Oil Ltd.)

Oil Sands Soil Reconstruction Program Steering Committee (Alberta Environment, Alberta Forest Service, industry)

Oil Sands Soil Reconstruction Program Technical Committee (Alberta Environment, Alberta Forest Service, industry)

Olympic Secretariat Climate Advisory Committee (Alberta Recreation and Parks)

Panel for Energy Research and Development (PERD) (Alberta Environment, Environment Canada)

Plains Aquatic Research Group (Alberta Environment, Environment Canada, Fisheries and Oceans Canada, Saskatchewan Environment, University of Calgary, Montana State University)

Plains Coal Reclamation Research Program (PCRRP) Geochemistry Subcommittee and Soil/Crop Subcommittee

Plains Coal Reclamation Research Program (PCRRP) Steering Committee (Alberta Environment, Alberta Energy and Natural Resources, industry)

Reclamation Research Technical Advisory Committee (RRTAC) (Alberta Environment, Alberta Energy and Natural Resources, Alberta Agriculture, and Alberta Research Council)

Research Review and Analysis Committee (RRAC)

Second Symposium/Workshop on Acid Forming Emissions in Alberta and Their Ecological Effects Steering Committee (Alberta Environment, University of Calgary, Energy Resources Conservation Board, Canadian Petroleum Association)

Statistics Co-ordinating Committee (Alberta Bureau of Statistics)

Surface Water Research Advisory Committee (Alberta Environment, Alberta Research Council, Environment Canada)

Third International Symposium on Regulated Streams Organizing Committee (Alberta Environment, Syncrude Canada Ltd., University of Calgary, University of Alberta)

Turtle Mountain Study Team (Alberta Environment, Alberta Energy and Natural Resources, Alberta Disaster Services, Alberta Culture)

Water Subprogram Committee, Alberta Research Council (Alberta Environment, Alberta Agriculture, Alberta Transportation, Alberta Research Council, University of Alberta, Canada West Foundation, Irrigation Secretariat)